20.28

(a) [1,5]-hydrogen shift (carbon to nitrogen)

(b) [3,3]-shift (Cope)

(c) [3,3]-shift (Claisen)
Chapter 20

20.30

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(a) 

(b) 

(c) 

[2,3]-shift

[1,5]-shift

[2,3]-shift

5-orbitals
6 electrons
2 node MO

suprafacial
the product from the initial Claisen could tautomerize and stop the process by making the phenol; one argument for the second sigmatropic reaction is that the Claisen product was crowded, so the $E_{\text{ACT}}$ for getting the next reaction was lower than the first (given that it needed to be high enough $E$ to break the aromatic ring) - the “para” product is less hindered
This question really requires a plan, starting with “where is the other double bond?” As is often true, the instructions pave the way: make an enol from the ester.
(a) Based on this information, draw the mechanism and provide the missing intermediates.

(b) The reaction with the deuterium substituted methyl groups could easily demonstrate that this was not a [1,5]-methyl shift. What would be the outcome from the deuterium labeled compound?